CP/M®

(Control Program for Microprocessors)

EXCLUSIVELY FOR THE

TRS-80®

Model 4

MONTEZUMA
MICRO

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1. THE MANUAL

CP/M (Control Program for Microcomputers) was created in the late 1970's by Gary Kildall of Digital Research. CP/M has been called a "standard operating system", with some justification, and a very large number of programs have been written that run under it. Your Model 4/4P CP/M 2.2 supports all correctly written applications for this version.

This users manual for CP/M 2.2 for the TRS-80 Model 4/4P is designed to supply the information necessary to operate CP/M on the TRS-80 Model 4. It provides as non-technical a discussion as possible and attempts to cover the utility programs and disk drive/terminal interfaces provided by Montezuma Micro using a basic step-by-step approach. The explanations will, at times, leave the reader wanting far more information than has been presented. We respectfully direct your attention to the CP/M manual furnished with the system and the numerous items referenced at the end of this work.

In the explanations that follow, **bold printing like this has been used to show what you will see on the video display.** The text associated with the display is printed in normal type. You will also see many references to "Control" keys, which will usually be written as the "^" character followed by a letter. When you are instructed to type such a key sequence the "^" is a signal to push down and hold the CTRL while pushing the letter key. For example to type ^C, one of the most common control sequences, you would push and hold the CTRL key, then push the 'C' key, and finally release both keys.

While we have tried to make this users manual as accurate as possible, it is inevitable that errors exist and will be discovered. Please use the Bug Report (REPORT.BUG on the CP/M disk) and let us know. We do not offer cash rewards or free trips for the best or most Bug Reports, but we do offer our thanks for your help, and will respond to the best of our ability to correct problems you may encounter.

Please read the following information carefully at least once so that you may get some idea of the versatility of the system. Always label your diskettes so you can keep track of the many formats possible using this system. Get in the habit of pressing ^C or BREAK every time you change a diskette as CP/M expects it and sooner or later you will regret not learning this quaint little custom.

This revision of release 2 of our CP/M reflects enhancements that our users have requested, as well as new features that we have added. Our sincere thanks to all those who sent in suggestions.

Jesse Bob Overholt

2. UPGRADE POLICY

Your purchase of our product is deeply appreciated. We feel that once you have purchased our CP/M 2.2 you need not purchase it again as some "new release." You may upgrade your original disk, at any time, to the then current version with no charge except for handling and shipping which currently amounts to $15. The following procedure must be followed:

1. We must have your signed registration card on file.
   No Card — No Upgrade.

2. You must return the original disk to us for upgrading. Be sure it is insured. We are not responsible for articles lost or damaged in transit. Protect yourself:
   INSURE YOUR DISK
   No Original Disk — No Upgrade.

3. In return you will receive either your old disk back or a new disk with the latest version of CP/M 2.2 and the various utilities on it along with a new set of documentation such as this.

Please allow sufficient time for the disk to reach us, get updated, and returned to you. This could take as long as a couple of weeks depending on the season and workload. Please don't call and ask about your disk until two full weeks have elapsed. We do our utmost to see that every upgrade gets processed with a minimum of delay.

You may upgrade as many times as you wish as long as we are still producing the product. This policy applies only to CP/M 2.2 for the TRS-80 Model 4/4P. If Digital Research comes out with a CP/M 5.5 some time in the future and we choose to release it for the Model 4/4P it will be considered a new product and you will not be able to "upgrade" to it for the shipping and handling charge per the above instructions.

3. THE CP/M DISK

The following software modules are supplied on your disk:

- Digital Research's CP/M 2.2 operating system customized by dear old Monte
- Digital Research Utility Programs:

ASM DDT ED STAT LOAD DUMP
MOVCPM SYSGEN SUBMIT XSUB PIP

- Montezuma Micro Utility Programs:

EXBIOS CONFIG DUP KEYDEF

- Montezuma Micro Files:

DISK.FDF REPORT.BUG

- Other programs and files may be added from time to time. These will usually have supporting documentation in files with a file type of '.DOC'. Be sure to read this documentation.

The disk format used on this distribution disk is Montezuma Micro Standard SYSTEM Disk format, defined as follows:

- Double Density
- Single-sided
- 40 tracks
- 18 sectors per track
- 256 bytes per sector

4. GETTING STARTED

Before turning on your computer to try out your copy of CP/M, please take a moment to make sure that there are not disks in any of the disk drives. This is an important rule to remember -- never turn the computer **ON** or **OFF** with a disk in it. Magnetic pulses created when power is applied or removed can alter data fields on a disk and create read or write errors.

Once the computer has been turned on, place the CP/M diskette in drive A:. This is the bottom drive on a Model 4 computer, or the left drive in a Model 4P. Insert the disk with the write-protect notch to the left (Model 4 desktop) or down (Model 4P portable). If in doubt please consult the manual that was provided with your Model 4 computer. When the disk is loaded close the door on the drive and push the RESET switch on the computer. In a few moments the computer will beep and display the following:

```
TRS-80 Model 4 64k CP/M vers 2.2 (c) (p) 1982 Digital Research Inc.
BIOS vers 2.xx (c) (p) 1984 Montezuma Micro/JBO
```

If the above message fails to appear at the top of your screen, don't panic. Remove the disk and run through this checklist:

1. Make sure the disk was properly inserted into the drive. On the Model 4 the label should be face up and the write-protect notch should be to the left. On Model 4P the label is to the left and the write-protect notch is to the bottom.

2. Check the brightness and contrast controls on the computer. They may have become adjusted to the point where there is no longer a visible display on the screen.

3. OK, this is obvious, but it does happen. Make sure the computer is plugged in!

4. If your computer is a Model 4P and it has a hard disk drive connected you must hold down the F2 key until CP/M displays its banner. Otherwise the computer will try to load the operating system from the hard disk.

5. It is possible, although not very likely, that your CP/M disk is defective. In such cases the loading program will display the message "BOOT error!" on the screen. Sometimes just pushing reset a few times will cause a successful load, but if the disk was hit with a magnetic field in its journey from us to you it may be simply unreadable. Before returning it to us try it on another Model 4, if possible. If there is a problem with your computer the disk will work on another system. In such cases consult your dealer for assistance in getting the computer working properly.

If you need to return the disk to us, please ship it <u>prepaid and insured!</u> All the information in the **UPGRADE POLICY**, except the cost, also pertains here.

If your computer contains the optional 64k memory expansion, with a total of 128k of memory, you will also get the following display:

```
>>> Memory Drive M: ENABLED
```

This message is an indication that the extra memory has been set up to appear to CP/M as a 64k disk drive. More information about this feature is contained in the section headed **MEMORY DISK DRIVE.**

Following this "sign-on" information CP/M will display a listing of the files on the CP/M diskette. File names which end in '.COM' are commands that CP/M can execute. Those with a '.DOC' extension are documentation, often for a '.COM' file of the same name. You can (and should) list the '.DOC' files using the CP/M TYPE command. See your CP/M reference book for more information.

The first thing you should do with your new copy of CP/M is to make a backup copy of it. This is done using the Disk Utility Program, or DUP for short. To run this program boot the distribution disk and wait for the command prompt (A>) and then hold down the CTRL key and push the F1 key. The word DUP will appear on the screen and the Disk Utility Program will load. In a few seconds the following menu will appear:

```
TRS-80 Model 4 CP/M 2.2 Disk Utility Program version 1.xx
Copyright (c) (p) 1984 Montezuma Micro/JBO

[ A ]   Format a disk
[ B ]   Copy a disk
[ C ]   Check a disk for errors

Select [ A - C ], or BREAK (▲C) to exit.  Your choice: [ ]
```

Since we want to make a backup we choose item B. Note that it does not matter whether the disk we are copying to has been formatted or not. The copy routine will do that for us. At this point a second menu will appear, indicating that we are copying a disk. This menu is as follows:

```
Select the drive to copy from (SOURCE):

Drive   Physical drive & current format
[ A ]   0:    Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ B ]   1:    Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ C ]   0:    Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ D ]   1:    Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ E ]         Undefined disk drive
[ F ]         Undefined disk drive
[ G ]         Undefined disk drive
[ H ]         Undefined disk drive
[ I ]         Undefined disk drive
[ J ]         Undefined disk drive
[ K ]         Undefined disk drive
[ L ]         Undefined disk drive
[ M ]         Fixed storage device or Undefined disk drive if 64k
[ N ]         Undefined disk drive
[ O ]         Undefined disk drive
[ P ]         Undefined disk drive

Select [ A - D ], or BREAK (▲C) to exit.  Your choice: [ ]
```

With so many choices this menu can be overwhelming, but only the first four choices will be accepted. The others are there to handle expansion of your CP/M system, with additional disk drives or hard disk systems. For now just select drive A: as the disk to copy from. As soon as this selection is made another menu appears, just like the previous one except the top line reads as follows:

```
Select the drive to copy to (DESTINATION):
```

Since we are performing a first-time backup, select drive B:. This brings us the next menu:

```
Copying  FROM  the disk in drive A:, physical drive 0
   Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)

Copying  TO  the disk in drive B:, physical drive 1



Load the SOURCE and DESTINATION disks.  Push ENTER when ready.
```

The first line identifies the disk we are copying FROM, i.e. the disk we are making a copy of. On the second line that disk is described as having 40 tracks and being Single Sided, Double Density, with 170K of storage space. Below that the drive we are copying TO is identified. This is where the blank disk should be loaded.

Since we are copying the system disk it should already be in drive A:. You may want to put a write protect tab on it if there isn't one on it already, just to be sure. Now put a blank disk in drive B:, which is the top drive on the Model 4 (or right drive on the 4P). Check everything over, and push ENTER. If for some reason a mistake has been made and you want to start over, just push BREAK.

DUP now checks the disk in drive B: to make sure it is blank. If it finds something on the disk the following message will be displayed:

```
***** WARNING *****
This disk is NOT BLANK!  OK to DESTROY all information on it (Y/N)?
```

If the above message appears check the disk in drive B: carefully to make sure that it doesn't contain anything you need to keep. To return to the "Load disk" prompt answer with 'N', otherwise once you are sure about the destination disk answer 'Y'.

Copying now proceeds, track by track. Each track requires four separate steps, displayed as follows:

```
Copying track ........... 0
  Formatting                 [ ]
  Reading                    [ ]
  Writing                    [ ]
  Verifying                  [ ]
```

The cursor will display between the brackets for each phase of the copy. If an error should occur it will be displayed at the bottom of the screen. Some errors are correctable, such as having a write-protect tab on the destination or leaving a drive door open, while others cannot be overcome. If an uncorrectable error occurs while reading it will be necessary to return the disk to us. Errors during formatting, writing, or verifying can be due to flaws in the disk that you are writing to, or a problem with your computer. Try using another disk. If that doesn't solve the problem you will need to have your computer checked.

When the entire disk has been copied the following message will be displayed:

```
Copy complete.
Push ENTER to repeat, BREAK (▲C) for menu.
```

Push BREAK to return to the main menu. Remove your original CP/M disk from drive A: and put it in a safe place. Do not use this disk again, except to make more backup copies. Move the new copy from drive B: to drive A: and push the RESET button. CP/M should load and display its banner, just like the original disk did. If it does not, take your computer in for a check of the disk drive alignment.

You are now ready to explore your new Montezuma Micro CP/M system. Please continue reading this manual! It contains a lot of good information that will help you use CP/M more effectively. Thank you for your purchase!

5. KEYBOARD

Because the TRS-80 Model 4 keyboard does not contain the entire ASCII character set it is necessary for some keys to produce characters that do not appear on their keytops. The following list shows all the characters that are produced in this way, along with aids in remembering these assignments.

Character	Keys to generate	Memory aids & hex value
ESC	SHIFT CLEAR	ESCape often used to CLEAR errors (1BH).
L. brace ([)	CTRL (	Braces are controlled parentheses (5BH).
Left slant	CTRL /	Left slant similar to right slant (5CH).
R. brace (])	CTRL)	See above for '[' (5DH).
Vertical bar	CTRL 1	"Odd" characters from odd numbers (7CH).
Tilde	CTRL 3	See above (7EH).
Carat (^)	CTRL 5	See above (5EH).
Accent	CTRL 7	Opposite of apostrophe on 7 key (60H).
Underscore (_)	CTRL -	Minus resembles underscore (5FH).
L. curly brace	CTRL <	"<" & ">" resemble braces (7BH).
R. curly brace	CTRL >	See above (7DH).
DEL	CTRL CLEAR	DELete by CLEARing away (7FH).

Some keys on the keyboard perform specialized functions under CP/M. Most of these can be modified using the KEYDEF or CONFIG utilities. The following list refers to how these are defined on the standard CP/M distribution disk.

Key	Character or action generated
UP ARROW	Generates ^K (0BH), which is Vertical Tab character.
DOWN ARROW	Generates ^J (0AH), which is linefeed.
LEFT ARROW	Generates ^H (08H), which is backspace.
RIGHT ARROW	Generates ^I (09H), which is Horizontal Tab.

Note - the above 4 keys generate the same codes, whether used alone, with SHIFT, or with CTRL. This may be changed with KEYDEF or CONFIG.

BREAK	Generates ▲C (03H) in all modes.
CLEAR	Generates ▲X (18H), which is CANcel.
SHIFT CLEAR	Generates ▲[(1BH), which is ESCape.
CTRL CLEAR	Generates DEL (7FH), which is DELete code.
CAPS	Locks/unlocks the letter keys in/out of upper case. Since there is no visual indication of the state of the lock a short "beep" is given when the lock goes "on", i.e. all upper case letters.

The functions keys (F1,F2, and F3) perform a special function in Montezuma Micro CP/M. Each one can be programmed to generate from 1 to 10 characters. In the copy of CP/M that we ship to you the keys are defined according to the following table. If you create a CP/M system using MOVCPM or SYSGEN the function keys will simply announce their names when pushed. Use KEYDEF or CONFIG to define them for your own purposes.

Function key	Command definition
F1	DIR A: <ENTER>
F2	DIR B: <ENTER>
F3	DIR M: <ENTER>
SHIFT plus F1	PIP A:=
SHIFT plus F2	PIP B:=
SHIFT plus F3	PIP M:=
CTRL plus F1	DUP <ENTER>
CTRL plus F2	CONFIG <ENTER>
CTRL plus F3	STAT

Several control codes are recognized by CP/M when typing in commands. These codes may also work in programs which use the built-in CP/M keyboard functions. The following table lists the codes which you can use:

Code	Function
^C or BREAK	Perform a CP/M Warm Boot (Reload CP/M from disk)
^E	Start a new line
^H or LEFT ARROW	Backspace and delete character to the left of cursor
^I or RIGHT ARROW	Tab 8 columns to the right
^J or DOWN ARROW	End current line (Same as ^M)
^M or ENTER	End the current line
^P	Turn printer on or off (toggle)
^R	Redisplay current line
^S	Stop display on screen and wait for another key Resume display on any key but ^C
^U	Delete a line (by starting over on the next line)
^X or CLEAR	Erase the current line and start over
^Z	End input from CON: to PIP and ED

6. VIDEO CONTROL CODES

The Video Display driver in Montezuma Micro CP/M responds to the same control codes as the Lear-Siegler ADM-3A terminal. **This is a very popular terminal and is the one you select when asked for your terminal type during the install procedure of most CP/M application programs.** We have added nine additional codes (indicated below by '*') to handle the situations that we have encountered where standard ADM-3A codes were insufficient. The following control codes and sequences implemented:

Code name	Symbol	Description
Bell	BEL	Control G 07 hex Sound the bell (beeper).
Backspace	BS	Control H 08 hex Move the cursor non-destructively one character position to the left.
Tab	TAB	Control I 09 hex Move the cursor non-destructively to the next tab stop (every 8 columns).
Linefeed	LF	Control J 0A hex Move the cursor non-destructively down one line (scroll if on last line).
Vertical tab	VT	Control K 0B hex Move the cursor non-destructively up one line (no action if on top line).
Formfeed	FF	Control L 0C hex Move the cursor non-destructively one character position to the right.
Return	CR	Control M 0D hex Move the cursor non-destructively to the left end of the current line.
Shift out	SO	Control N 0E hex * Turn reverse video OFF on next character.
Shift in	SI	Control O 0F hex * Turn reverse video ON on next character.
Clear EOL	NAK	Control U 15 hex * Clear from cursor to end of current line.
Reverse	SYN	Control V 16 hex * Toggle the state of reverse video on the next character.
Insert Line	FS	Control ¢ 1C hex * Insert a blank line at the cursor position.

Delete Line	GS	Control]	1D hex *	Delete the line at the cursor position.
Clear EOS	EM	Control Y	19 hex *	Clear from cursor to end of screen.
Clear	SUB	Control Z	1A hex	Clear screen and home cursor.
Home	RS	Control A	1E hex	Move the cursor non-destructively to the top left corner of the screen.
Position Cursor Row + 32 Column + 32	ESC = yy xx	Control [= yy + 20 hex xx + 20 hex	1B hex 3D hex	This is a four-character sequence which puts the cursor at row yy, column xx. See the discussion which follows.
Cursor Off	ESC 0	Control [0	1B hex * 30 hex	Turn the cursor off.
Cursor On	ESC 1	Control [1	1B hex * 31 hex	Turn the cursor on.

The 4 character ESC sequence for cursor positioning deserves some special mention. Before sending this sequence to the Video Display you should first determine where you want the cursor on the screen. The X coordinate may range from 0 to 79, and Y can vary from 0 to 23. Once you have the X and Y values add 32 to them. This step is necessary since some values might be the same as some control codes. Send the ESC character (1B hex), the '=' (3D hex), the Y value (Y + 20 hex), and the X value (X + 20 hex).

The following BASIC subroutine will position the cursor as required. It requires two input parameters, ROW and COL which specify the row and column numbers respectively.

```
1000 '     Cursor Positioning (Similar to LOCATE command)
1010 '     Input:      ROW=Row number (0-23)
1020 '                 COL=Column number (0-79)
1100       PRINT CHR$(27);"=";CHR$(ROW+32);CHR$(COL+32);
1110       RETURN
```

Special Note

The codes listed above are meant to be used by programs which send them to the screen through the CRT: drivers in the BIOS. You CANNOT see the effects of these codes simply by typing them on the keyboard because the program that you are entering into may not be echoing every character that you type to the Video Display.

7. DISK DRIVES and CP/M

7.1. A drive by any other name ...

The CP/M operating system refers to disk drives by letter, starting with A: for the first drive and going up to P:, depending on how many drives are available. Radio Shack documentation refers to the disk drives by number starting with 0 and going up to 3, again depending on how many drives your system has. This dual system makes for easy confusion. The purpose of this section of the manual is to sort things out and attempt to make sense out of chaos.

In a simple, "plain vanilla" CP/M system there are at most four disk drives, identified as A:, B:, C:, and D:. Drives E: through P: come into play only when such exotic devices as hard disk drives or memory disk drives are used. For purposes of this discussion we will assume a simple two drive system.

It should be noted that the numbers assigned to the drives by Radio Shack are physical device addresses that cannot be changed. Thus drive 0 is always the bottom drive of a Model 4 or 4D (or left drive in a 4P), drive 1 is always the top (right), and so on. Since these addresses are permanent we can use them to describe the drives, e.g. physical drive 0 will always refer to the bottom (or left) drive.

CP/M, on the other hand, is much less particular. It does not know, or care, which drive is drive A:, only that it can read and write to it. Since CP/M uses these labels only as logical addresses we refer to them as logical drives. Labeling of the drives is done using the CONFIG utility. Normally drive A: is physical drive 0 and drive B: is physical drive 1. Logical drives C: and D: could be left undefined, but they offer a useful tool at the expense of a little complexity.

Since CP/M always reloads itself from drive A: (whichever physical drive it may be) then drive A: should be in Montezuma Micro Standard SYSTEM disk format. Drive B:, however, could be virtually any format. We might choose to make B: in Montezuma Micro Standard DATA disk format, so as to have more storage to work with. This works well until the first time that we need to use PIP to transfer a file from one SYSTEM disk to another SYSTEM disk. Since drive B: is in DATA disk format we cannot use it for reading or writing SYSTEM disks. If only we had four drives then we could use two for SYSTEM disks and two for DATA disks.

But wait! Our CP/M system will let us have four logical drives (A:, B:, C:, & D:), so long as we don't try to use more than two physical drives. Suppose we assign drives A: and B: to physical drives 0 and 1 in SYSTEM disk format. Then we could assign C: and D: also to physical drives 0 and 1 in DATA disk format. This would allow us to have four "logical" drives using only two "physical" drives. Such a scheme is not only possible, but the CP/M disks that we ship are configured in this way. It's a very powerful tool, but like a power saw, requires a great deal of responsibility from the operator. Think about what happens if we try to get a DIR from drive D: while we have a SYSTEM disk in drive B:. The system will report strange directory information, or it might just hang up altogether. Our point is that you can call the same physical drive by more than one logical drive name, but you have to be very careful. It might even be worthwhile to physically put stickers on each drive to identify what logical drive it currently is being used as.

7.2. Buffers, bytes, and things that go bump on the disk

The basic unit of disk storage within CP/M is a 128 byte block called a sector. In the early days when CP/M was developed this was the standard size for a disk data block, but technology has improved disk drives to a point where 128 byte sectors are terribly inefficient. In accommodation to CP/M the BIOS (Basic I/O System) allows all disk drives to be accessed as though they contained 128 byte sectors, even though the disk may physically contain sectors of up to 1,024 bytes. To do this the BIOS maintains a block of memory called a buffer into which it reads "real" sectors which are parceled out to CP/M 128 bytes at a time.

Many things have been done to streamline this process, thereby making CP/M more efficient. One thing the BIOS does in this regard is to always check the buffer before reading a sector, to see if the required sector is already in the buffer. If it is, no read needs to be done and the sector may be given to CP/M immediately. This is a great time-saver, but it does create some situations that need to be mentioned.

Suppose you have a stack of diskettes, one of which contains a program called ZORT.COM. You don't know which disk the program is on, so you stick one in drive B: and type DIR B:. CP/M displays the directory, which contains only a single file called FARKLE.TXT. You take that disk out, put in another one, and type DIR B: again. Again you get only a single file called FARKLE.TXT. You repeat the process for nine more disks and get nine more FARKLEs. What happened? Has something mysteriously cloned FARKLE.TXT onto all your disks?

If you were paying close attention you would have noticed that drive B: was accessed only once, when reading the first disk. Every time after that when CP/M called for the first directory sector it was already in the BIOS buffer, and was not read from the disk. Therefore all you got was one directory ten times.

How can we prevent this error? The best way is to type AC (Warm Boot) after every disk change. During a Warm Boot the BIOS "forgets" what information is in the buffer, so all disk I/O starts over. This is also a good idea if you are changing diskettes, since R/O (Read Only) status is removed from all drives during a Warm Boot. Of course you should only change diskettes while at the CP/M command prompt (A>, B>, etc.) since a disk change in the middle of a program could cause unexpected results. Do this only if the program tells you to do so.

In spite of our best intentions and efforts, not every disk operation is successful. The BIOS disk driver makes every effort to perform each I/O (Input/Output) operation by retrying up to 9 times. If all retries fail the error will be indicated by the BIOS to the software module that made the disk I/O request. In most cases this will be the Basic Disk Operating System (BDOS), which is legendary for its cryptic error messages. When the BIOS detects an error while performing a BDOS function it will report the error with the following message:

```
Disk error on X: ?
```

The X will be replaced by the actual drive where the error occurred (A:, B:, C:, etc.), and the '?' will be replaced by one or more letters which indicate the type of error or errors that occurred.These letters are as follows:

M: During a disk operation the drive motor timed out and turned off. This may be caused by a number of things. If the letter M appears alone the drive either has no disk in it, the disk is inserted incorrectly, or it cannot be recognized by the drive. In cases where one or more other letters appear after the M you should disregard the M error, since it was a consequence of another problem.

W: A write operation has been requested on a disk which is write-protected. Check the disk for the presence of a write-protect tab.

F: During a disk write operation a write fault has occurred. This is due to a malfunction of the drive electronics or the disk controller. Should you receive this code with any frequency it is an indication that your computer needs to be serviced.

S: The sector which was requested for reading or writing could not be found on the disk. You may be trying to read a disk on a drive which is not set in the correct format, or the disk itself may be flawed.

C: During a disk operation a CRC error was detected, indicating that erroneous data was transferred. This error is usually due to worn or damaged media, dirt in the drive, or misalignment of the drive. Consult your computer dealer for service or assistance.

D: Data loss during a disk read or write is indicated. This error usually is indicative of a program problem, and thus would not be expected. If you get this error it probably means that something has gone wrong with the internal "clock" of your computer causing it to run slower than normal.

When the "Disk error" message is displayed you may push any key to try the I/O again, or ^C to return to the CP/M command prompt. Type 'M' and 'W' errors will be successful on a retry, providing that you correct the condition that caused them in the first place. The other types of errors, however, are usually not recoverable and you should not be surprised or upset when no amount of retrying succeeds.

Disk errors can come from a variety of sources, but the most common are dirt and magnetic "glitches." Dust, cigarette smoke, and fingerprints are some of the contaminants that can prevent reliable disk reading and writing. Telephones, magnetic paper clip holders, and other "innocent" sources of magnetism can create minute changes in the recorded patterns of a disk. To prevent such problems keep your work area free of anything magnetic. Don't smoke, eat, or drink near the computer. Use a disk drive head cleaner if necessary, and keep current backup copies of all important diskettes.

8. MEMORY DISK DRIVE

When CP/M is first booted due to power-up or reset it checks to see if the extra 64K RAM module is installed. If it is, this memory will be configured as a memory disk drive. CP/M will announce this by displaying "**>>> Drive M: ENABLED**" following the sign-on banner.

Drive M: functions just like a normal disk drive except that it has only 63K available plus a 1K directory (32K with Monte's Window installed) and is much faster. You can do anything on drive M: that you can do on any other disk drive. Just remember that when the computer is turned off or reset everything on drive M: disappears! Using the memory drive for disk-intensive programs (such as overlays) can result in significant time savings.

There are a few considerations that you must keep in mind about drive M:. First, CP/M does not test the extra 64K of RAM other than to establish whether it is present. Rather than making you wait for several seconds on every boot, we have chosen to believe that the extra RAM is good. If you want to test the RAM yourself you can use PIP to do it. Just copy files to drive M: with the verify option, as in the following example:

```
PIP M:=A:*.DOC[V]
```

You cannot SYSGEN on drive M:, nor can you boot from it. CONFIG will not allow you to change drive M: in any way. CP/M will not use drive M: for anything unless it is explicitly told to. Using drive M: does not add any overhead to CP/M, and you cannot reclaim any memory by not using it. It is truly the fabled "free lunch", costing you nothing but the chips to enable it!

9. DISK FORMATS

9.1. The Philosophy

One of the most popular features of Montezuma Micro CP/M is its ability to read, write, and format diskettes in formats with computers made by a wide variety of manufacturers. The list of formats supported has grown to the point that it now changes almost on a daily basis. To simplify maintenance to this list, and also allow you to add your own formats to it, we have moved all format information into a disk file.

This file, DISK.FDF, is included on your CP/M master disk and is used only by CONFIG (system CONFIGuration utility) and DUP (Disk Utility Program). Both of these programs are capable of functioning if the DISK.FDF file is not available, since the sixteen standard Montezuma Micro disk formats are built into the programs. Although there is no limit to how many formats may be stored in this file, only the first 112 will be used by DUP or CONFIG. This is not a limitation, however, since it is possible to have more than one disk format file.

When either DUP or CONFIG is run it looks for DISK.FDF on the default drive. If a drive number or file name is specified in the command line then the utility will use that drive or file name instead. The following examples illustrate how this works:

Command line	Format file & drive used
DUP	DISK.FDF on the current drive
CONFIG B:	DISK.FDF on drive B:
DUP MYDEF	MYDEF on the current drive
DUP B:YOURDEF.VS1	YOURDEF.VS1 on drive B:
CONFIG A	A on the current drive (A: would be drive #)

Each drive "remembers" what format is assigned to it by the position of the format in the file. That means if you change the file, or use a different file than was used in CONFIG the name of the format will change. Suppose we have three formats in our DISK.FDF file:

Albatross 420 (40T, SS, DD, 156K)
Muckup 250 (35T, DS, DD, 325K)
Zulu IV (40T, SS, DD, 188K)

We assign the Albatross format to drive A:, then delete it from the DISK.FDF file. Later we run DUP and are surprised to find that drive A: is now using Muckup format. The reason? We assigned the first entry in the file to drive A:, and then deleted the first entry. That made Muckup the first entry, which is what drive A: was assigned.

In designing this file system we considered giving each format its own number, so the above problem could not occur. This raised even more problems, however. Who assigns the numbers? What happens if we run out of numbers? What if I don't want the formats that are provided on my disk? As a result we gave up on the number idea and decided to let each user tailor the format file to meet his or her own needs. To prevent problems, just remember to run CONFIG after each change to the format file to make sure that each drive is configured the way that you want it.

9.2. Montezuma Standard Formats

As previously mentioned there are sixteen standard Montezuma Micro disk formats which are available for use by CONFIG and DUP even if the DISK.FDF file is not. In general they fall into two classes: SYSTEM disk formats and DATA disk formats. SYSTEM disk formats reserve the first two tracks for storage of the CP/M operating system, which is placed there using either the SYSGEN or the CONFIG utility. DATA disk formats have no reserved tracks and cannot be used to make bootable disks. The various combinations possible with 40 and 80 track drives and single and double sided drives account for the sixteen formats available. The first 8 of these formats are the Standard SYSTEM and DATA formats, while the second 8 are the Extended SYSTEM and SUPER DATA formats that offer much more storage than their Standard counterparts. See Configuring Non-standard SYSTEM Disks for information on creating a disk in the Extended SYSTEM disk format. Please note that such disks will require loading the Model III ROM image to be booted on a Model 4P due to their use of 512 byte sectors which the 4P interprets as being a Model III disk.

9.3. Rolling Your Own

It is unlikely that any one user will need or want ALL the formats that we have provided in DISK.FDF. Some of them are so exotic that there may not be ANYBODY who wants them. We have arbitrarily placed them in the file in alphabetical order by the name of the manufacturer. As the list grows longer we may have to use multiple files. In any case you may edit the file using ED.COM, or a more capable editor, to remove entries you don't want or to move those used most often to the front of the list. You might also add some of your own formats, using the guidelines which follow. Whatever you do, please do it on a **BACKUP** copy of your CP/M disk so you don't destroy the one that we shipped you! Bear in mind that erroneous formats in the DISK.FDF file will simply be ignored without comment, so if the format that you added doesn't show up in the CONFIG menu check it over carefully for errors.

Every format in the file has three lines, each terminated by a carriage return and line feed. (This is consistent with nearly all "big name" word processors, as well as good ol' ED.COM.) The first line must begin with a '*' followed by one to sixty characters of descriptive information. We have chosen to put the manufacturer's name & model first, followed by the specifications in parentheses. Here we list the number of tracks, single or double sided, single or double density, and the capacity in kilobytes. For example, standard Montezuma SYSTEM format is listed as (40T, SS, DD, 170K). You need not follow this convention, since this text is displayed without regard for content.

Generating the second line will require the services of a genuine CP/M software "guru." It contains the information that goes into the Disk Parameter Block (DPB) in the BIOS, along with some other things that the BIOS likes to know. If you are not a water-walking bit fiddler it is recommended that you skip to the next section. The format of this second line is as follows:

```
RPT,BSH,BLM,EXM,DSM,DRM,AL0,AL1,CKS,OFF,SPT,SSZ,NTK,OPT
```

All entries are in decimal, with commas being mandatory. DO NOT use spaces between items. The fields are:

RPT=Records Per Track, i.e. the number of 128 byte sectors/track
BSH=Block SHift count
BLM=BLock Mask
EXM=EXtent Mask
DSM=Disk Storage Maximum, i.e. the largest block # possible
DRM=DiRectory Maximum, i.e. the largest directory entry
AL0=ALlocation vector 0
AL1=ALlocation vector 1
CKS=Directory ChecK Size
OFF=Track OFFset, i.e. the number of reserved tracks
SPT=Sectors Per Track, i.e. the number of "real" sectors
SSZ=Sector SiZe code 0=128, 1=256, 2=512, 3=1024
NTK=The Number of TracKs required (35, 40, 77, or 80)
OPT=OPTion bits, i.e. value of 8 bits

Bit	Usage
7	Density required (0=Single, 1=Double)
6	Sides required (0=Single, 1=Double)
5	Reserved - leave as 0
4	Data status (0=Normal, 1=Inverted) Note - only Intertec Superbrain is known to use inverted data.
3	Double-sided sector bias 0=Sector numbering same on both sides 1=Sector numbers on side 1 continue from side 0
2	Double-sided track numbering 0=Track number same on both sides 1=Track number increments on side change
1	Side alternation on double sided drives * 0=Use both sides before changing tracks 1=Use all of side 0, then use side 1
0	Disk side 1 usage if OPTion bit 1 is set to 1 * 0=Use side 1 starting at track 0 & go upwards 1=Use side 1 starting at last track & go downwards to 0

* Bits 0 & 1 effective only if EXBIOS active.

The third line consists of the numbers of the true sectors in the order that they are to be accessed in, commonly referred to as the "interleave." There should be as many entries here as indicated in SPT above, but in no case should there be more than 30 entries. It is also very important that the lowest numbered sector on the track be listed first. If the format uses no interleave (usually due to formatting the disk with sectors in interleaved sequence) enter the sector numbers in consecutive order.

Here is an example of a completed format definition for the Montezuma Micro Standard SYSTEM disk format:

```
(Line 1)        *Montezuma Micro Standard SYSTEM (40T, SS, DD, 170K)
(Line 2)        36,4,15,1,84,127,192,0,32,2,18,1,40,128
(Line 3)        1,3,5,7,9,11,13,15,17,2,4,6,8,10,12,14,16,18
```

Double sided disk formats may present some problems. The Montezuma Micro BIOS regards the double-sided disk as having twice as many tracks as it really has, with the even tracks being on side 0 and the odd tracks being on side 1. This is a fairly common method and is used by many other formats. Some manufacturers, however, double the RPT value and use a sector out of range as the signal to change sides. Such formats can be used if you simply enter RPT as half the value that is used on the original machine. Others use all of side 0 before using side 1. OPT bits 0 and 1 control this.

Another problem is the number of reserved tracks. On double sided drives we regard this value to be the number of logical tracks, i.e. side 0 and side 1 constitute two tracks. If the disk whose format you want uses this value as a true track count (BOTH sides reserved) then you will have to double this value when entering it into the file.

Once you have defined your format go into CONFIG, assign it to a drive, and test it. Be cautious in testing. It is often possible to get a DIR display, even though the format is incorrect. Even more frustrating is a disk which has no files, since "NO FILES" could mean a blank disk, or an incorrect format definition. Strange characters in a DIR display usually indicate a problem with the sector interleave.

9.4. Formats to go -- Placing Your Order

We at Montezuma Micro want to continue to increase our library of disk formats, and we encourage you to send us those that we haven't got yet. To get the information that we need you will need to run a short program on the machine whose format you are interested in. You will also need to make a diskette on that machine, with at least one file (but preferably more) on it. The content of the files is not important as long as we can tell by examination that they have been correctly read. Text files are good for this, even contrived test data such as "1111", "2222", etc. Please don't send Apple or Commodore disks as they can only be read on those machines.

To run this program you will need DDT.COM, STAT.COM, and a printer on the target machine. First log onto the disk to be tested. This is done simply by typing its name and a colon, e.g. 'B:'. If you don't do this step then the information gathered will be for another drive and may be invalid. Then run STAT by typing as follows:

```
STAT DSK:AP
```

The AP should be typed prior to pushing the ENTER (or RETURN) key on the keyboard. It will cause a report to be printed on the printer that looks something (but NOT EXACTLY) like this:

```
 A: Device Characteristics
???: 128-Byte Record Capacity
???: Kilobyte Drive Capacity
???: ??-Byte Directory Entries
???: Checked Directory Entries
???: Records/Extent
???: Records/Block
???: Sectors/Track
???: Reserved Tracks
```

On your report all the question marks will be replaced by numbers that specify how CP/M uses the disk drives on your machine. Now run DDT by typing the following command:

```
DDT <ENTER>
```

This command should print on the printer, since we have directed output on the screen to be copied to the printer. If it didn't you have probably pushed AP a second time and canceled the screen to printer copy. Go back to the beginning and start over. Once you are in DDT type in the following program (computer responses shown in boldface type):

```
-A100 <ENTER>
0100 MVI C,1F <ENTER>
0102 CALL 5 <ENTER>
0105 <ENTER>
-G100,105 <ENTER>
*0105
-X <ENTER>

C0Z1M0E1I0 A=E9 B=F500 D=0000 H=F5E9 S=0100 P=0105 LXI B,4F43
```

The important information is in this last line following "H=", although the numbers displayed (F5E9) will almost certainly not be the same as the ones in this example. Type a D followed by this address and a carriage return (or ENTER):

```
-DF5E9 <ENTER> (Use YOUR number)
```

Several lines of hexadecimal information will be printed out. This is the essence of the format information that we need. Send it, along with the sample disk, to us here at Montezuma. Please include the <u>EXACT NAME AND MODEL</u> of the computer the disk was made on and the serial number from your Montezuma Micro CP/M disk. We'll put our crack format decoding team to work on it and send you back a new DISK.FDF file containing your format on the disk that you sent us.

There is no charge for this service. It's just another freebie from Monte. Remember now, don't send us those nasty little Apple or Commodore CP/M disks. Nobody can use them but Apple and Commodore. Sorry.

9.5. Copying/Reading/Writing non-Montezuma Disk Formats

In many cases, when purchasing CP/M applications programs for use on your Model 4/4P using our CP/M, it is necessary to specify another manufacturer's disk format (such as Kaypro), since some software is not available in the Montezuma disk format. This is perfectly OK, since we have the ability to read many other manufacturer's disk formats via the CONFIG program.

There are a couple of rules that apply here: First, you should specify a disk format that is compatible with your disk drives. Do not specify a double-sided disk format (such as Televideo) if you only have single-sided disk drives. When in doubt, the Kaypro 2 disk format (40 track, Single-Side, Double Density) is a good choice. Once you have acquired your software in an appropriate format, the following procedure is suggested to convert the programs to the Montezuma disk format. A two drive system is assumed.

1. Boot up on a backup copy of your Montezuma CP/M system disk (hereafter referred to as the "system" disk).

2. Place a blank disk in drive B: and type DUP and press the ENTER key. Follow the menu and format the disk in drive B:. When the format is complete exit the DUP program and you will return to the A> prompt.

3. At the A> prompt type SYSGEN and press the ENTER key. You will be asked for the source drive; type A. When prompted to place the source drive in A:, press the ENTER key since the disk is already there. When asked for the destination, type B and then press the ENTER key. The system information will then be written to the disk you formatted in drive B:. After the SYSGEN is successfully completed and you are prompted again for the destination drive, press the ENTER key to quit and you will be returned to the A> prompt.

4. From the A> prompt type the following:

   ```
   PIP B:=A:PIP.COM
   ```

   This command will copy the "PIP" program from drive A: to drive B:. When this process is complete you will be returned to the A> prompt.

5. At the A> prompt, enter the CONFIG program. From the main CONFIG menu select the "G" option (Disk Format Definitions) and change drive B: to the disk format you want to copy from (Kaypro, etc.). Follow the instructions outlined in the Disk Format Definitions section of your manual if you are unfamiliar with this procedure. When you are finished return to the A> prompt.

6. Remove the system disk from drive A: and set it aside. Take the disk you just formatted and sysgened from drive B: and place it in drive A:. Do a control C (hold down the CTRL key and press the C key) to inform CP/M that you have changed diskettes.

7. Place the diskette with the non-Montezuma disk format you want to copy in drive B: and type the following:

   ```
   PIP A:=B:*.*
   ```

This command will copy all of the files from non-Montezuma format disk to the Montezuma disk in drive A:. When the process is complete you will be returned to the A> prompt. Remove the non-Montezuma disk from drive B: and press the RESET button. You are now ready to install and/or run your application program.

NOTE: When performing step #7 (above) it is possible to receive a "Disk Write Error" under certain conditions. This normally would indicate the destination disk is full or it is write protected. Some non-Radio Shack disk formats will hold more data than can be put on the Montezuma standard system disk format. In this case you must put the remaining uncopied files on another diskette.

10. CONFIG

The CONFIG utility is provided with Montezuma Micro CP/M so that you may tailor the system to match your hardware. A tremendous amount of modification is possible, so it is strongly recommended that you read this section thoroughly and carefully before trying to use CONFIG.

To use CONFIG simply type CONFIG at the CP/M prompt. The program will load and display the following menu:

```
TRS-80 Model 4 CP/M 2.2 CONFIG version 3.xx
Copyright (c) (p) 1984 by Montezuma Micro/JBO


Configuration options:

[ A ]     System device assignments
[ B ]     Keyboard definitions
[ C ]     Video Display definitions
[ D ]     Parallel printer definitions
[ E ]     Serial port definitions
[ F ]     Disk drive definitions
[ G ]     Disk format definitions
[ H ]     Save current configuration on disk

Select [ A - H ], or BREAK (AC) to exit.
Your choice: [ ]
```

Note — if you are using **Monte's Window**, **SYS2M**, or some other Montezuma Micro utility program which modifies CP/M the 'H' option will not be present in the above menu. This is done automatically to prevent saving a modified system to disk. To get the 'H' option on your menu simply reboot without activating any utility programs and run CONFIG again.

We will discuss each option in detail. An option is selected simply by typing the letter corresponding to it. To return to CP/M just push the BREAK key, or type AC.

10.1. System device assignments

Within CP/M is a structure called the IOBYTE, located in memory at location 3. This byte is used to tell the BIOS which physical devices to assign to the CP/M logical devices CON:, RDR:, PUN:, and LST:. The initial menu for this option will display the device assignments currently in effect:

```
[ A ]    CON: (Console)   = CRT:  Keyboard in, Video out
[ B ]    RDR: (Reader)    = TTY:  Serial port input
[ C ]    PUN: (Punch)     = TTY:  Serial port output
[ D ]    LST:  (List)     = LPT:  Parallel port output

Select [ A - D ], or BREAK (▲C) to exit.
Your choice:  [ ]
```

The settings shown above are the default values that CP/M is shipped with. Yours may differ if you have changed your configuration. If you do not wish to change any of the device assignments simply push BREAK to return to the main CONFIG menu. Otherwise type the letter next to the device that you wish to change. Each logical device has its own menu of physical devices that may be assigned to it. We will discuss each device in turn. In making device assignments remember that they are immediate. Do not assign a device if you are not prepared to start using it right away.

CON: - the CP/M console

The console device is where CP/M and most programs get instructions. It may be used for either input or output. Device choices for the console are:

```
[ A ]    TTY: Serial port in & out
[ B ]    CRT: Keyboard in, Video out
[ C ]    BAT: Batch (RDR=in, LST=out)
[ D ]    UC1: User defined console
```

The TTY: device is the RS232 serial port in the Model 4. If assigned to the console it will be used for both input and output. Do not assign this device until you have configured the serial port to match your terminal or modem.

CRT:, which is the default choice for CON: refers to the TRS-80 keyboard for input, and the video display for output. This is the normal choice for the CON: device.

The BAT: device is really two separated devices. When input is requested from BAT: it is taken from whatever is assigned to the RDR: device. Output goes to whatever is assigned to LST:. This was originally designed so that long streams of paper tape input could be input into CP/M for unattended operation. One possible use for this device now might be to direct all CON: output to the printer, useful when running programs that do not allow for printed output.

UC1: is intended to be a user-defined console device. As such it is not defined, but we have set it up to act just like CRT: so that the system will not crash if it is accidentally selected.

RDR: - the CP/M reader device

In the original implementation of CP/M the reader was actually a paper tape reader. Mercifully such devices have become extinct, but the memory lingers on. RDR: now serves as an auxiliary device, usually used for serial I/O. Your choices are:

[A] **TTY: Serial port input**
[B] **PTR: Keyboard input**
[C] **UR1: User-defined reader 1**
[D] **UR2: User-defined reader 2**

TTY: refers to the RS232 serial port, although only the input portion is used. The terminal, or other device, must provide its own character echo, as CP/M will only input from this device.

Since the Model 4 does not have a paper tape reader we have assigned the keyboard as the PTR: device. This device is input only, so you will not be able to see the characters as you type.

UR1: and UR2: are both user-defined reader devices. They have both been assigned to a null device which performs no function, but should keep the system from hanging up if accidentally assigned.

PUN: - the CP/M punch device

Like RDR: this device originally referred to a paper tape punch. Now it is most commonly used as a serial output device. Device choices are:

[A] **TTY: Serial port output**
[B] **PTP: Video display output**
[C] **UP1: User-defined punch 1**
[D] **UP2: User-defined punch 2**

TTY: is the RS232 serial port of the Model 4, with only the output portion being used.

PTP: goes to the video display for output, since there is no paper tape punch on the Model 4.

UP1: and UP2: are both assigned to null devices, which perform no function other than to keep the system from hanging.

LST: - the CP/M list device

The LST: device is commonly used when programs want to print information on a printer. It is an output only device. The test for LST: busy is available for all devices which may be assigned to it, so LST: may be efficiently used for word processors which need the busy test, such as WordStar. Choices are:

[A] **TTY: Serial port output**
[B] **CRT: Video display output**
[C] **LPT: Parallel port output**
[D] **UL1: User-defined list**

TTY: is the RS232 serial port, used only for output. This would be the logical assignment to make if you wanted to use a serial printer with CP/M.
CRT: is the Model 4 video display. You might want to make this assignment to direct printer output to the screen.

LPT: is the normal assignment when you want to use a parallel printer connected to the Model 4 printer port.

UL1: is a user-defined device, which is directed to a null device driver to prevent system hang-up through inadvertent use.

10.2. Keyboard definitions

Most of the keys on the keyboard have dedicated functions that cannot be changed. However the four arrow keys, BREAK, CLEAR, and function keys may be redefined to suit your needs. When you make this menu selection the following will be displayed:

```
[ A ]   Standard keys:  ARROWS, BREAK, & CLEAR
[ B ]   Function keys:  F1, F2, & F3
[ C ]   Repeat factor:  128
```

Choose the key group that you wish to modify, C to change the rate at which keys repeat when held down, or push BREAK (or ^C in case you have modified BREAK) to return to the main CONFIG menu.

If you choose A in the above menu you will get this display:

```
      UNSHIFTED              SHIFTED                CONTROL
[ A ] CLEAR           [ G ]  CLEAR           [ M ]  CLEAR
[ B ] BREAK           [ H ]  BREAK           [ N ]  BREAK
[ C ] UP ARROW        [ I ]  UP ARROW        [ O ]  UP ARROW
[ D ] DOWN ARROW      [ J ]  DOWN ARROW      [ P ]  DOWN ARROW
[ E ] LEFT ARROW      [ K ]  LEFT ARROW      [ Q ]  LEFT ARROW
[ F ] RIGHT ARROW     [ L ]  RIGHT ARROW     [ R ]  RIGHT ARROW
```

From this menu you may choose any of the 18 keys to be changed. Those in the UNSHIFTED column correspond to the keys used alone. In the second column are the keys used with SHIFT, and the third is each of the six keys combined with CTRL. Let's suppose that we wanted to change the SHIFT/UP ARROW key to generate the ESCape character, which is 1BH or 27 decimal.

We located UP ARROW in the SHIFTED column and find it represented by the letter I. Pushing I we get the following:

Definition:

Pushing ENTER or BREAK at this point will return to the menu and leave the selected key unchanged. Otherwise enter the character which the key is to generate when pushed. If you want the key to represent a control code, which is the case in our example, you must enter two characters. The first must be the '^' character, which is generated by typing CTRL/5 on the keyboard, while the second is the character which is being used for the control sequence. In our example we get the ESC code by typing ^[. Please note that this is two separate key entries. First is CTRL/5, which gives us the '^' character, and second is CTRL/8 which generates the '[' character. Note that while entering this definition you can backspace to correct typing errors, etc. The definition is not accepted until you push ENTER. If you type more than two characters on the line, only the first one will be taken.

Using this notation every key in the ASCII code set may be generated with the exception of two. The ASCII NUL (null) code, which is 0, may not be specified at all since the BIOS keyboard handler uses that code for internal purposes. DEL, the ASCII delete code with a value of 7F hex, 127 decimal, is the other exception. We have chosen to define it using the sequence '^@'. Normally ^@ would generate a null, but since we can't use nulls it is interpreted as DEL.

There is one situation in key definition that deserves special mention. Throughout this entire CP/M system we have made reference to the BREAK key as a means of generating the ^C code. In this program it is possible to change the definition of BREAK so that it no longer generates ^C. If you should do that none of the "Push BREAK" prompts will work as advertised. Keep this in mind and use ^C when you need to define BREAK to mean something else.

Choosing B from the key definition menu will lead to this:

```
        UNSHIFTED            SHIFTED             CONTROL
[ A ]   F1           [ D ]   F1          [ G ]   F1
[ B ]   F2           [ E ]   F2          [ H ]   F2
[ C ]   F3           [ F ]   F3          [ I ]   F3
```

This menu presents the nine function keys that may be defined. Push BREAK to exit, or choose a key by entering its letter. This will lead to the following prompt:

Definition:

At this prompt pushing BREAK will return to the menu and leave the key defined as it was. Pushing ENTER, however, will remove the definition assigned to that key and make it inoperative. If neither of these is what you want then type in the definition for the key. Up to 8 keystrokes may be defined for each function key. Remember, if you want to enter a control code in the key definition you must enter it as two characters. The first will be '^' and the second will be the letter associated with that control code. ENTER, for example, is defined as ^M. When control codes are entered in this way they only count as 1 character in the key definition, even though they take 2 characters to type in.

Choosing C at the Key Definition menu will generate the following prompt:

Enter new repeat factor:

You may enter any number from 1 through 255. The smaller the number, the faster they keys will repeat. CP/M is shipped with a value of 128. Some experimenting may be necessary to find the optimum value.

10.3. Video Display definitions

Montezuma Micro CP/M uses the same video control codes as the Lear Siegler ADM-3A terminal. We have also added nine additional codes to this set in order to simplify interfacing some programs. They are: Control N, "Reverse Video Off"; Control O, "Reverse Video On"; Control V, "Reverse video on/off toggle"; Control U, "Clear from cursor to end of current line."; Control Y, "Clear from cursor to end of screen."; Control ¢, "Insert line."; Control], "Delete line."; ESCape 0, "Turn cursor off."; and ESCape 1, "Turn cursor on."

For some users, however, this may not be enough. Perhaps you have a program that wants to use some other code, or you don't like the ones we have picked. This section of CONFIG allows you to assign the 14 control codes that we did NOT use as duplicates of the 17 codes we did use. In other words, it lets you perform a given function with more than one code.

If you choose this option you will be presented with a list of the codes which are unassigned. Select the code that you wish to define. This will lead to a display of the video functions that can be performed. Select the one that you want your code to perform and you are done.

For a complete discussion of the standard video control codes see the **VIDEO CONTROL CODES** section elsewhere in this manual.

10.4. Parallel Printer definitions

Choosing this option allows you to define how the printer is to be handled. Please note that these options pertain ONLY to the parallel printer port and will NOT work with a serial or other device assigned to LST:. The menu for this option looks like this:

[A] **Suppress linefeed after carriage return: YES**
[B] **Simulate formfeed (top-of-form code): NO**
[C] **Page length in lines: 66**

The settings shown are the values on CP/M as shipped. Yours may vary from this.

Item A refers to how the printer responds to a carriage return. Some printers perform a linefeed automatically after every carriage return and cannot conveniently be stopped from doing this. By setting this item to "YES" you will cause CP/M to filter out any linefeeds which immediately follow carriage returns. A simple test to find out if you need this option is to print out some text using ^P and TYPE. If everything comes out double-spaced then you need to suppress the extra linefeeds.

Printers which do not recognize the formfeed code (0C hex, 12 decimal) will be benefited by option B. Setting this value to "YES" will cause CP/M to simulate the formfeed by counting lines and issuing repeated linefeeds when a formfeed is received. Item C, the page length in lines dictates how many lines will be spaced. This item has meaning only if item B is set to "YES". Each time a Warm Boot is done in CP/M (usually after each program) the page length counter will be reset.

Once all printer options are set as you require, push BREAK to return to the main menu.

10.5. Serial port definitions

When you choose this option from the CONFIG menu you will get the following display showing the current settings for the serial port:

```
[ A ]   Baud rate:              300
[ B ]   Parity:                 None
[ C ]   Word length:            8 bits
[ D ]   Stop bits:              1
[ E ]   DTR line:               ON
[ F ]   RTS line:               ON
[ G ]   Wait for CTS:           NO
[ H ]   Wait for DSR:           NO
[ I ]   Invert CTS:             NO
[ J ]   Invert DSR:             NO
```

The values shown above are the defaults in effect when CP/M is shipped. Yours may vary. Each option may be changed by selecting the letter corresponding to it. Items that may have only two possible values (D through J) simply toggle when chosen. The others lead to sub-menus from which you may choose a new value.

Items A through D should need no explanation. E and F refer to the state of the Data Terminal Ready (DTR) and Request To Send (RTS) lines on the RS232 interface. If set ON those lines will be true (+12 volts), otherwise they will be false (-12 volts).

Communications protocol is set by items G and H. If G is set YES then no data will be sent out the RS232 port until Clear To Send (CTS) becomes true. Likewise item H will prevent output until Data Set Ready (DSR) is true. These items may be needed for some modems or serial printers. The polarity of these input signals may vary from one model of printer to another. If the signals are of opposite polarity you can use options I and/or J to invert them to the proper polarity for testing.

Whenever any item in this menu is changed the RS232 port is immediately initialized to the new parameters. Such an initialization occurs at no other time except when CP/M is first booted up in a Cold Boot (Reset).

10.6. Disk drive definitions

Choosing this option will produce a display of the physical drives in the system:

[A] Physical disk drive 0
[B] Physical disk drive 1

[C] Number of drives: 2

The display shown above is what is on the CP/M disk as shipped. If you have more than two drives it may have more choices, but the LAST choice will still be "Number of drives." Please be very careful with this menu! To remain consistent we have stuck with the convention of lettering the menu choices. In this menu, however, it tends to suggest that A refers to drive A:, and so on. It does not! Selection A refers to physical drive 0, which might be drive A:, but certainly does not have to be. In this menu, which you will normally use only once (unless you add drives to your system), we are defining the physical characteristics of the disk drives.

The last item on this menu (Number of drives) affects only the choices that CONFIG will allow you. Set it to reflect the number of disk drives that you actually have and then forget it. Selecting any physical drive will produce a heading identifying which drive was chosen, followed by this menu:

[A]	**Type of drive:**	**5 inch**
[B]	**Number of tracks:**	**40**
[C]	**Number of sides:**	**1**
[D]	**Step rate (ms):**	**6**

Choosing either item A or C will simply toggle between the two choices. The type of drive is either 5 inch (OK five and a quarter, so we took a little poetic license!) or 8 inch, and the number of sides must by either 1 or 2. For operational purposes a 3 and 1/2 inch drive is considered to be the same as a 5 and 1/4 inch drive. The standard TRS-80 Models 4 and 4P are supplied ONLY with 5 and 1/4 inch single-sided drives, while the Model 4D has double-sided drives of the same size. Any other type of drives must be purchased by the user as a separate option. Item B will present another menu of track choices. Sizes available are 35, 40, 77, and 80. Note that changing the drive type to 8 inch will automatically set the track count to 77 and it will not be possible to change it. The Model 4 will not read an 8" double density disk due to hardware limitations of the disk controller. This option has been placed in the system for possible future use. In choosing track sizes be sure to pick what the drive actually has. If your drive has 80 tracks, but you want to use it to read 40 track disks, you should still enter 80. CONFIG will make the necessary changes for you to read 40 tracks later on. Do not choose 35 tracks unless your drive only has 35 tracks. A 40 track drive will be accepted for 35 track formats.

Choosing item D will present a menu of track step rates. The choices for 5 inch drives are 6, 12, 20, and 30 milliseconds, while for 8 inch drives they are 3, 6, 10, and 15. All standard Model 4 drives will step at 6 milliseconds, as will most 80 track drives. If in doubt consult the drive specifications or contact the drive manufacturer. When all drive specifications are complete push BREAK to return to the main menu.

10.7. Disk format definitions

This menu option will probably be the one that you use the most often. It allows you to define the format that is to be used for each disk drive in your CP/M system. To make full use of this feature CONFIG must have access to the disk file containing the format definitions that you will be using. On the CP/M distribution disk this file is DISK.FDF, which is the default name. For a full discussion on the format definition file please refer to the section on DISK FORMATS.

Selecting this menu option will produce the following display on the console:

```
Drive  Physical drive & current format
[ A ]  0:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ B ]  1:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ C ]  0:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ D ]  1:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ E ]  Undefined disk drive
[ F ]  Undefined disk drive
[ G ]  Undefined disk drive
[ H ]  Undefined disk drive
[ I ]  Undefined disk drive
[ J ]  Undefined disk drive
[ K ]  Undefined disk drive
[ L ]  Undefined disk drive
[ M ]  Fixed storage device or Undefined disk drive if 64k
[ N ]  Undefined disk drive
[ O ]  Undefined disk drive
[ P ]  Undefined disk drive

Select [ A - D ], or BREAK (^C) to exit.
Your choice:  [ ]
```

The formats shown in the above display are those that are installed on the CP/M distribution disk. Yours may be considerably different depending on how many drives you have and how they are configured. All sixteen drives are listed on this menu, even though only four of them can be used. (NOTE: Drive M: is added to CP/M automatically on systems which have had the optional 64k memory addition for a total of 128k. Drive M: may be used for all CP/M operations, but may not be configured in any way other than it is installed. With the advent of hard disk drives, and other storage systems, it is possible that you could have more than four drives, and that the floppy disk drives might be assigned to drives other than A:, B:, C:, and D:.

Notice that although four CP/M drives (A:, B:, C:, and D:) are shown on this menu, only two physical disk drives (0 and 1) are shown. Drives A: and C: both refer to physical drive 0, while drives B: and D: refer to physical drive 1. This has been done to allow more flexibility in a two drive system. We can set either of the two physical drives to be either a SYSTEM disk or a DATA disk just by calling it by the right name. These assignments could just as easily be different manufacturers. For example, drive C: might be a Kaypro and drive D: might be Superbrain. As far as CP/M is concerned, there are four drives, even though we know there are only two.

Since a given disk drive can only hold one diskette you have to be especially careful what name you call it by. Using the above assignments, if you are referring to physical drive 0 as drive C:, then it must contain a DATA disk, which does not have a copy of CP/M on it. If you were to do a ^C at this time CP/M would try to read the operating system from drive A:, which of course it could not. The result would be a complete hang-up of the system. Use extreme caution when assigning multiple CP/M drives to the same physical drive!

Now back to the menu -- pushing BREAK returns you to the main CONFIG menu. Otherwise choose the drive that is to be defined. This will lead you to a menu containing eight formats and a ninth choice labeled "More format choices." The last choice is the default, so repeatedly pushing ENTER will page you through all the formats available. Since the list is circular you will eventually come back to the first page. If the DISK.FDF file was not available when CONFIG was loaded there will be only two pages to the format menu, containing the sixteen standard Montezuma Micro formats. Keep cycling until you find the one you want and select it by letter (or push BREAK to exit).

Once you have chosen a format you will be prompted for a physical drive number. This choice will be a number from 0 to 3 (or less if you have less than 4 drives). After the drive is specified CONFIG checks to see if the format can be used on the drive you have chosen. If a problem is found, such as trying to use a double-sided format on a single-sided drive, CONFIG will beep and ask for another drive number. This process will continue until CONFIG is happy with your choice or you push BREAK, whichever comes first. CONFIG will not install a format until it is sure that the format can work on the chosen drive. Config will also, if necessary, set an 80 track drive to doublestep on a 35 or 40 track format. BE VERY CAUTIOUS WHEN USING 35 OR 45 TRACK DISKS ON AN 80 TRACK DRIVE! They can be read with no problem, and will appear to write without problems. However data which is written on the disk under these conditions may not readable when the disk is returned to its original 35 or 40 track drive. The reason is that the read/write head of the 80 track drive writes 96 tracks per inch, as opposed to the 48 tracks per inch written by 35 and 40 track drives. These tracks are much narrower, and therefore very difficult to read on 35 and 40 track drives.

An IMPORTANT NOTE: Any disk format that contains a '*' character in its description requires an extension to the BIOS to handle it correctly. This extension is installed using a program called EXBIOS.COM, which is included on your CP/M system disk. It is run simply by typing EXBIOS at the CP/M prompt. EXBIOS will announce the modification with the following:

```
EXBIOS version 2.xx
BIOS Extension complete.
```

This extension needs to be installed only once after each complete Cold Boot (Reset) of CP/M, but no harm will come from running it more than once. If you use EXBIOS on a regular basis you may wish to set it up to be run automatically when CP/M is booted. See section 11.8 for information on how to do this.

When the required formats are assigned as you wish to all drives push BREAK to return to the main menu.

10.8. Save current configuration on disk

After you have configured CP/M to meet your needs it is natural to want to save that configuration for future use. Choosing this option allows you to do just that.

First you will be prompted for the CP/M drive (not the physical drive) on which to save the configuration. Enter A:, B:, etc. for the drive to be used. Normally this drive will be in Montezuma Micro SYSTEM disk format, but other formats may be used including those of other computers. For a format to be accepted it must be double density, have at least 2 but not more than 8 reserved tracks, and use normal (not inverted) data. It must also not be on an 80 track drive stepping double for 40 track use. If CONFIG finds fault with the drive you have selected it will reject it and request another. This process will continue until you give CONFIG a drive that it can live with, or you push BREAK.

After the drive has been specified CONFIG will ask for the command that you want CP/M to execute when it is Cold Booted (Reset). This may be any valid CP/M command or program name. Your CP/M disk was originally configured to perform the MDIR command. If you do not wish to have a special command done at reset time just push ENTER. Otherwise enter what you want CP/M to do.

Next CONFIG will ask whether you want drive M: activated if CP/M is booted on a 128k system. An answer of 'Y' will cause drive M: to be activated (and formatted) each time CP/M is booted on a 128k machine. Answering 'N' will prevent drive M: from being activated on any boot. This option would normally be used only in cases where the extra 64k of RAM was to be used for purposes other than as a memory disk drive.

Finally CONFIG will ask whether you want the CP/M sign-on message to be displayed at reset time. If you are creating a turnkey system enter N to suppress the sign-on. Otherwise respond with 'Y' for normal messages. Note that the "Drive M: ENABLED" display will occur ONLY if the sign-on message is enabled.

Following this CONFIG writes the configured CP/M on the designated disk. You will then be prompted to push ENTER to return to the main menu.

10.9. Configuring Non-standard SYSTEM Disks

The standard Montezuma Micro SYSTEM disk is a double-density, single-sided, 40 track disk with a capacity of 170K bytes. This corresponds to the standard disk drives in the Model 4 and 4P computers. You may have other disk drives, such as double-sided, 80 track drives, or a Model 4D which has double-sided drives. It is possible to configure a system around any mix of disk drives as long as you are able to boot the CP/M distribution disk in drive A:. The following procedure will guide you through the process.

1. Make a backup copy of your CP/M distribution disk if you have not already done so. This is very important, because if something goes wrong you need to have a disk to start over from.

2. Using your backup, run CONFIG and define your hardware configuration setting everything except disk formats ([G] on the main menu). Make sure that the disk drives ([F] on the main menu) are properly defined. DO NOT save this configuration on disk at this time.

3. Now choose [G] on the CONFIG menu and define the non-standard SYSTEM format to be used. You may choose any drive EXCEPT drive A:. For the time being drive A: must be left as a standard SYSTEM disk since we need to use it for reading programs and CP/M. Again DO NOT save the configuration on disk.

4. At this point everything should be configured as you want except for drive A:. Say, for example, that your system has two double-sided drives. You would now have drive B: configured as double-sided, but drive A: would still be set a single-sided. Push BREAK to exit CONFIG.

5. From the CP/M prompt (A>) type DUP and press ENTER. This will run the Disk Utility Program. Format a blank disk on a drive which is the same as drive A: will be in the final configuration. Using our example of two double-sided drives, we would format drive B:, which is double-sided just like drive A: will be when we finish. When formatting is complete push BREAK to return to CP/M.

6. Now use PIP to copy all the files on drive A: to the disk formatted in step 5. In our example system we would say:

   ```
   PIP B:=A:*.* <ENTER>
   ```

7. When PIP finishes type CONFIG and press ENTER to return to the configuration utility. Select menu item [G] and select the format to be used for drive A:. This format should match the format of the disk created in step 6. At this time you may also wish to select the formats to be used for the other disk drives. When the proper format has been set for drive A: save the configuration on the drive created in step 6 (B: in our example).

8. You now have an operational system disk, which should be placed in drive A:. Exit CONFIG with BREAK and begin processing in the new configuration!

11. KEYDEF

As has been mentioned in previous sections, it is possible to modify the characters produced by the ARROW, BREAK, CLEAR, and FUNCTION keys. While these keys can be easily changed using the CONFIG utility, that is hardly a convenient method if the keys are to be changed more than once or twice. It might sometimes be advantageous to change the key definitions frequently, to match the requirements of application programs.

These problems were responsible for the creation of the KEYDEF utility. Just as we store disk formats in a file, it is possible to store key definitions in a file. Whenever you want to redefine the keyboard you use the following command:

```
KEYDEF filename <ENTER>
```

The file name is the name of a text file created by ED, WordStar, or some other text editor. It contains the key definitions for those keys that are being redefined. Any legal CP/M file name may be used. The file name extension (file type), if not specified, will be taken as '.KDF' for Key Definition File. If no file name is specified KEYDEF will restore all keys to the default values that are specified in the **KEYBOARD** section of this manual.

A key definition file consists of one line for each key to be defined. The general format of each line is as follows:

```
KN=X
```

KN stands for Key Name and is one of 9 possible values taken from the following list:

Key Name	Key on keyboard
CL	CLEAR
BK	BREAK
UP	UP ARROW
DN	DOWN ARROW
LF	LEFT ARROW
RT	RIGHT ARROW
F1	F1 (Function key 1)
F2	F2 (Function key 2)
F3	F3 (Function key 3)

Suppose that we want to cause a CTRL-C (written as ^C) whenever the BREAK key is pushed. We enter the following definition into the file:

```
BK=^C
```

This example illustrates the only "tricky" thing about KEYDEF. Please note that the ^C above is entered as two separate characters. We typed in 'BK=', then the '^' character (generated by CTRL/5 on the keyboard), and finally the 'C' character. If you think about it, control characters have to be entered this way, since many word processing programs interpret control codes as commands. When KEYDEF processes a definition it checks for the '^' character. If found it is discarded and the next character on the line is converted to a control code.

Okay, fine, but how do we define SHIFTed and CTRL keys? This is done using the same key names as specified above with one more character. If a key name is preceded by '!' it is assumed to be SHIFT plus the key, while a key name preceded by '^' is taken as CTRL plus the key. Here are some examples of key definitions:

Key Definition	Definition Effect
!LF=^H	SHIFT LEFT ARROW gives ^H, or 08 hex
^CL=Z	CONTROL CLEAR generates a Z
CL=^Z	CLEAR gives ^Z, or 1AH
F1=Hello	F1 says 'Hello' when pushed
!F3=Shift F3	SHIFT F3 announces its name
!UP=^[	SHIFT UP ARROW gives ESCape code (1B hex)
^F3=DIR B:^M	CTRL F3 performs DIR B: command
!F1=ERA *.BAK^M	SHIFT F1 erases all .BAK files

As you can see, function keys may be defined as a string of up to 10 keystrokes, while the other keys can generate only a single character no matter how many are specified. Note that control codes in function key definitions must be specified using the '^' notation. The last example shows '^M', which is how the ENTER key is defined in a function key definition.

Using this notation every key in the ASCII code set may be generated with the exception of two. The ASCII NUL (null) code, which is 0, may not be specified at all since the BIOS keyboard handler uses that code for internal purposes. DEL, the ASCII delete code with a value of 7F hex, 127 decimal, is the other exception. We have chosen to define it using the sequence '^@'. Normally ^@ would generate a null, but since we can't use nulls it is interpreted as DEL.

Only two errors are reported by KEYDEF. One is a message indicating that the file name specified cannot be found. This could be due to an error in typing in the file name, or forgetting about the default file type of '.KDF'. Remember, if you call your file 'MYFILE' KEYDEF will be looking for 'MYFILE.KDF'.

If a line in the input file is found to be in error a message will be displayed indicating this, and the offending line will be displayed. KEYDEF will continue to process the rest of the file and install as many key definitions as it can. No other action will be taken, and if KEYDEF was called from a SUBMIT file that file will continue after KEYDEF has finished.

One final note — Throughout the system Montezuma Micro has taken the standard definition for the BREAK key to be ^C. If you change that definition you will have to use ^C in place of BREAK while operating many of the utilities in CP/M.

12. DUP

12.1. Introduction

The Disk Utility Program, or DUP for short, performs three functions. It initializes blank disks for use with CP/M, it makes copies of CP/M disks, and it checks disks for errors. DUP requires the DISK.FDF file, or an equivalent. See the DISK FORMATS section for more information about DISK.FDF. If the DISK.FDF file is not available DUP will still run, but all disk format descriptions will be limited to very basic format specifications.

To run the Disk Utility Program type 'DUP' and push the ENTER key. When the program has been loaded from drive A: the following menu will appear:

```
TRS-80 Model 4 CP/M 2.2 Disk Utility Program version 2.xx
Copyright (c) (p) 1984 Montezuma Micro/JBO


[ A ]     Format a disk
[ B ]     Copy a disk
[ C ]     Check a disk for errors


Select [ A - C ], or BREAK (▲C) to exit.  Your choice:  [ ]
```

From this menu simply choose the DUP function that you wish to perform (A, B, or C) or push BREAK (or ▲C) to return to CP/M. A complete description of each DUP function follows.

DUP will honor the disk formats established by CONFIG, even if the DISK.FDF file is not available. All DUP operations will take place according to the formats that the drives involved are configured for. Copy operations proceed according to the format of the source drive, but do not require the destination to be of the same format, as long as it is physically able to perform the operation. Note that DUP will not allow formatting or copying to an 80 track drive which is being double-stepped to accommodate a 35 or 40 track format. While this is physically possible, it will not produce a reliable disk due to the narrow track written by the 80 track drive head.

12.2. Formatting disks

Formatting is a process in which a disk is initialized with the control and timing information that allows it to be used by CP/M. New diskettes must be formatted before they can be used. It is also useful to be able to format existing disks, in order to change their characteristics. If you want to make a backup disk, however, it is not necessary to format the disk first. The Copy function of DUP will perform that for you.

To format a disk in DUP choose item A from the main menu. This will cause a second menu to appear:

```
Select the drive to format on:

Drive  Physical drive & current format
[ A ]  0:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ B ]  1:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ C ]  0:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ D ]  1:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ E ]  Undefined disk drive
[ F ]  Undefined disk drive
[ G ]  Undefined disk drive
[ H ]  Undefined disk drive
[ I ]  Undefined disk drive
[ J ]  Undefined disk drive
[ K ]  Undefined disk drive
[ L ]  Undefined disk drive
[ M ]  Fixed storage device or Undefined disk drive if 64K
[ N ]  Undefined disk drive
[ O ]  Undefined disk drive
[ P ]  Undefined disk drive

Select [ A - D ], or BREAK (▲C) to exit.  Your choice: [ ]
```

By now you are probably asking why the program gives you 16 drives to choose from, but only accepts A:, B:, C:, and D:. Due to the nature of the TRS-80 Model 4 you will never have more than four floppy disk drives to choose from. However, with the advent of hard disk drive storage systems it is very possible that the floppy drives will be assigned to logical drives other than A:, B:, C:, and D:. Therefore DUP is prepared to accept any floppy disk drive, no matter which letter it is assigned to.

Depending on how many disk drives you have, and how they are configured, your menu may not look exactly like the one above. Choose the drive that you wish to format on by entering its letter. If your choice is a drive which is not a floppy disk it will be refused and the above menu will still be displayed. To leave the format menu just type ▲C. Normally the BREAK key will produce ▲C, unless it has been configured for some other character.

Once you have selected the drive the following will be displayed:

```
Formatting on drive B:, physical drive 1
   Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)

Load the disk to be formatted and push ENTER when ready.
```

Again the drive letter, physical drive number, and format description may vary from the above. If you discover that an error has been made and you wish to return to the previous menu, just push BREAK (▲C). Otherwise load a blank disk into the designated drive and push ENTER. DUP will then examine the disk to see if anything is written on it. This test is made only in the density of the format that you have selected. That means if you are formatting in double density and you use a disk formatted in single density, then DUP will consider it to be blank. If DUP detects something on the disk it will display the following message:

```
***** WARNING *****
This disk is NOT BLANK!  OK to DESTROY all information on it (Y/N)?
```

If this message appears check the disk carefully to make sure it does not contain anything that you cannot afford to lose. Format will remove even the barest hint of any data that was on the disk. Push 'Y' if you want to use the disk, 'N' if not. A response of 'N' will return you to the prompt to load the disk to be formatted. You may also push BREAK (▲C) here to return to the main DUP menu.

Formatting proceeds one track at a time. When the last track has been formatted DUP will start reading each track in reverse order to be sure that all sectors on it are readable. This reading is done with no retries, so as to catch questionable areas on the disk. Any disk which gets errors during verify should not be used. When verification has completed the following announcement will be made:

```
Format complete.   No bad sectors found.
Push ENTER to repeat, BREAK (▲C) for menu.
```

If any errors were found the word "No" will be replaced by a count of the number of bad sectors. As stated before, discard any disk which has bad sectors on it. At this display you can push BREAK (or ▲C) to return to the main DUP menu, or push 'ENTER' to format another disk of the same type in the same drive. This can save time if you have a number of disks to be formatted.

12.3. Copying disks

It is always a good idea to make backup copies of the disks that you are working with. This is done in DUP using choice B from the main menu. When you choose this option the following menu will be displayed:

```
Select the drive to copy from (SOURCE):

Drive  Physical drive & current format
[ A ]  0:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ B ]  1:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ C ]  0:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ D ]  1:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ E ]  Undefined disk drive
[ F ]  Undefined disk drive
[ G ]  Undefined disk drive
[ H ]  Undefined disk drive
[ I ]  Undefined disk drive
[ J ]  Undefined disk drive
[ K ]  Undefined disk drive
[ L ]  Undefined disk drive
[ M ]  Fixed storage device or Undefined disk drive if 64K
[ N ]  Undefined disk drive
[ O ]  Undefined disk drive
[ P ]  Undefined disk drive

Select [ A - D ], or BREAK (▲C) to exit.  Your choice:  [ ]
```

Select the drive to copy from simply by typing its letter. As with the format function, there are far more choices than there are drives, and your menu may not look like this one. Only choices of existing floppy disk drives will be accepted. When the source drive selection is made another menu appears, just like the previous one except the top line reads as follows:

Select the drive to copy to (DESTINATION):

Note that DUP will not accept the same drive for both the source and destination. DUP will not do a single-drive copy. Selecting different logical drives that are assigned to the same physical drive will also not be accepted, since this would constitute a single drive copy. Once a legal pair of drives has been selected the following is displayed:

Copying FROM the disk in drive A:, physical drive 0
Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)

Copying TO the disk in drive B:, physical drive 1

Load the SOURCE and DESTINATION disks. Push ENTER when ready.

The first line identifies the disk we are copying FROM, i.e. the disk we are making a copy of. On the second line that disk is described as having 40 tracks and being Single Sided, Double Density, with 170K of storage space. Below that the drive we are copying TO is identified. This is where the blank disk should be loaded. Keep in mind that your display may be a great deal different from this one, depending on your disk drive configuration. As a matter of convenience the copy routine will automatically use the format of the source drive on the destination drive as long as the destination drive is physically compatible (the same or greater number of tracks and sides). You do not have to configure the destination drive for use with the copy option. This does not mean that DUP will convert a disk from one format to another. If the destination disk format will be different from that of the destination drive the following warning message will be issued directly under the "Copying TO " line:

***** WARNING! DESTINATION disk will have same format as SOURCE. *****

When the drives and format are what you want then load a blank disk and push ENTER. If for some reason a mistake has been made and you want to start over, just push BREAK to return to the prior menu.

DUP now checks the DESTINATION disk to make sure it is blank. If it finds something on the disk the following message will be displayed:

******* WARNING *******
This disk is NOT BLANK! OK to DESTROY all information on it (Y/N)?

The above message appears only if the disk is readable using the format of the disk we are copying. That means if you are copying a single density disk to a blank that is recorded in double density DUP will write over it without telling you that it is not blank. Don't depend on DUP to save your disks — check them carefully. This message is intended only to save you from writing over last year's tax information that you will need at tomorrow's audit. Once you are sure about the destination disk answer 'Y'.

Copying now proceeds, track by track. Each track requires four separate steps, displayed as follows:

```
Copying track ...........        0
  Formatting .............       [ ]
  Reading .................      [ ]
  Writing ..................     [ ]
  Verifying ................     [ ]
```

In the formatting phase, control information is written on the destination disk. Then the track is read, sector by sector, from the source disk. Once read, the data is written to the destination, and finally read from the destination to verify that it is written correctly. Ideally this process takes just over one second per track, or approximately 50 seconds for a 40 track disk. (These times double for double-sided drives.) If copying seems to take significantly longer than this, it may be an indication of a problem with disk drive speed. Drives which are running faster than 1% above recommended speed may copy much slower than drives that are correctly adjusted. Several other factors can affect the timing. One of these is sector "interleave." Standard CP/M convention calls for the sectors to be written on the disk in consecutive order. Programs reading the disk can rarely access it fast enough to get each sector before it goes by, so the operating system compensates by reading the sectors in an interleaved fashion. A typical scheme might be to read all the odd numbered sectors first, followed by all the even ones. Disk formats which follow this convention will copy normally. Some manufacturers, however, do not wish to place the burden of sector interleave on the software. They choose to physically record the sectors on the diskette in the proper interleave order, so that the software can access them consecutively. Disks formatted in this manner will be slow to copy, since it will take multiple revolutions of the disk to read in an entire track. The backup copies will also be slow to work with under Montezuma Micro CP/M, since they will be formatted without interleave.

The copy will proceed until the last track is copied, unless an error occurs. In the event of errors you will be given a chance to try again or simply start over with a new disk. If errors occur during the verification phase the new copy should not be considered reliable and should not be used. Assuming that no errors occur the following message will be displayed:

```
Copy complete.
Push ENTER to repeat, BREAK (AC) for menu.
```

Pushing ENTER will cause DUP to prompt for another set of disks to start another copy. BREAK will return you to the main menu.

Beware that the copy command may not be able to perform a full disk copy on disks made on other CP/M machines. The reason for this is that the system tracks may not be in the same density as the rest or the disk, or the number of sectors may vary. This is often the case when a bootstrap ROM is used to load CP/M. If an attempt is made to copy such a disk one of two things will happen. You may get read errors on the first few tracks (the system tracks) or the copy will proceed without error but will not boot on the machine that the disk was made for. In all such cases, however, you should be able to use the disk as a non-system disk for purposes of reading and writing files.

It is not necessary to have a SYSTEM disk in drive A: while using the DUP copy option. Once DUP has been loaded it will not access drive A: again until you exit the program. To copy a disk which does not have a system on it select A: as the source drive and some other drive as the destination drive. Just remove the system disk from drive A: when DUP tells you to load the disks. After the copy is complete replace the system disk in drive A:.

12.4. Checking disks

From time to time you may wish to check on a disk, just to make sure that all the sectors on it are readable. DUP can do this using the checking function, which is item C on the main menu. Selecting this option will produce the following display:

```
Select the drive to check on:

Drive  Physical drive & current format
[ A ]  0:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ B ]  1:  Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)
[ C ]  0:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ D ]  1:  Montezuma Micro Standard DATA disk (40T, SS, DD, 200K)
[ E ]  Undefined disk drive
[ F ]  Undefined disk drive
[ G ]  Undefined disk drive
[ H ]  Undefined disk drive
[ I ]  Undefined disk drive
[ J ]  Undefined disk drive
[ K ]  Undefined disk drive
[ L ]  Undefined disk drive
[ M ]  Fixed storage device or Undefined disk drive if 64K
[ N ]  Undefined disk drive
[ O ]  Undefined disk drive
[ P ]  Undefined disk drive

Select [ A - D ], or BREAK (^C) to exit.  Your choice: [ ]
```

As with other DUP functions, all drives will be displayed, although only four will be accepted. Choose the drive that you wish to use and type its letter. This will lead to the next display:

```
Checking the disk in drive B:, physical drive 1
   Montezuma Micro Standard SYSTEM disk (40T, SS, DD, 170K)

Load the disk to be checked and push ENTER when ready.
```

Be aware that the display you get will probably differ from the one shown above due to differences in drive configuration. Pay close attention, though, to the description of the format. If it is not the same as that of the disk to be checked, you may get errors reported that really aren't errors. This could happen, for instance, if you try to check a format using 18 sectors per track on a disk that has only 10 sectors per track. Conversely if you check a 10 sector per track format on an 18 sector per track disk you will not get any "phantom" errors, and the check will proceed at lightning speed. Checking proceeds on a track by track basis.

When disk checking has completed the following summary will appear:

Check complete. No bad sectors.
Push ENTER to repeat, BREAK (▲C) for menu.

If errors were found the word "No" will be replaced by an error count. Note that the check is performed without retry. This is done so that disk problems can be found before they become serious. Often a disk which shows up errors during check can be successfully copied using the copy function of DUP, since the read portion of copy uses an extensive retry process. To continue checking disks push ENTER, otherwise push BREAK (▲C) to return to the main menu.

13. MOVCPM

MOVCPM is a utility program which allows you to MOVe CP/M to a new place in memory. This may be necessary to install special drivers or other programs that are designed to reside in high memory. CP/M as distributed by Montezuma Micro is a 64k system, which means that memory is used right up to the 64k boundary. By using MOVCPM you could construct a 62k system, which would leave the top 2k of memory undisturbed.

To run MOVCPM you simply type its name at the CP/M prompt, along with two optional parameters:

```
        MOVCPM x y <ENTER>
```

Parameter 'x' is the memory size (in k bytes) for the CP/M system that you want. This can be a decimal number, ranging from 39 to 64, or simply a '?' if you want CP/M to figure out the maximum memory available. Unless you have a bad memory chip in your computer, the latter option will always come up with 64k. If you enter the size as a number, just specify 2 decimal digits, without the letter 'k'. Please note that it is VERY IMPORTANT that you DO NOT ATTEMPT TO CREATE A CP/M LESS THAN 39k! Due to the manipulations that the BIOS goes through to support the memory drive, a system less than 39k in size will hang up at boot time and will not work. SYSGEN makes a simple test for illegal system size, but you should still not use any size below 39k.

Parameter 'y' is either a '*' or is not specified at all. If you enter a '*' then MOVCPM will create the system that you specified and leave it in memory for SYSGEN. This is the preferred way of using MOVCPM. By omitting this parameter you tell MOVCPM to generate the required system and then immediately install it in its proper place in memory. The effect will be the same as if you had just reset the computer, with one important exception. If the system generated is not the same size as the one recorded on the disk in drive A: then the system will malfunction or hang up the first time the BIOS is called upon to do a Warm Boot. This normally occurs at the end of a program, or when ^C is typed.

Here are some examples of MOVCPM commands, with descriptions of what each one does:

MOVCPM 60 *	Create a 60k system and leave it in memory for SYSGEN.
MOVCPM ?	Create a maximum (64k) system and begin using it now.
MOVCPM 48 *	Create a 48k system and leave it in memory for SYSGEN.
MOVCPM	Create a maximum (64k) system and begin using it now.
MOVCPM 24	Illegal size -- system crash will follow quickly!

It is important to note that using MOVCPM generates a completely new system. That means that all configuration information, including key definitions, will be set back to the default state. Therefore you will have to run CONFIG and KEYDEF on the new system in order to configure it the way you want.

Generally you will follow these steps:

1. Create the system in memory with MOVCPM.
2. Write that system to disk with SYSGEN.
3. Boot the new system from the new disk (Using the reset switch).
4. Run KEYDEF to establish your preferred key definitions. If you run KEYDEF without any parameters it will reset the key definitions to the standard values that CP/M is shipped with.
5. Configure the new system with CONFIG and write it back to disk.

MOVCPM can also be used to generate a CPMxx.COM file where 'xx' is a memory size in kilobytes. To do this simply run MOVCPM as outlined above. When it finishes MOVCPM will display this message:

```
CONSTRUCTING 64k CP/M vers 2.2
READY FOR "SYSGEN" OR
"SAVE 44 CPM64.COM"
```

If you type the SAVE command as instructed it will copy the system from RAM to a disk file which may then be used in subsequent SYSGEN operations. As mentioned before any disk created this way will still need to have key definitions and configuration information added to it using KEYDEF and CONFIG.

MOVCPM is not particularly selective about the memory size that you specify. For example, if you tell it to create a 65k system it will merrily proceed to create some Frankenstein system that tears up the village. Use caution in your entries! Under some conditions it will report "INVALID MEMORY SIZE", but don't depend on it.

Another message that may show up is the meaningless "SYNCHRONIZATION ERROR." This may mean that the copy of MOVCPM on your disk has become farkled, or it may have detected an attempt to run MOVCPM on a system which is not the same serial number as yours. Tell your cheap brother-in-law to buy his own copy!

If you are using MOVCPM to create space in upper memory for special software utilities, drivers, etc., please consult the Memory Usage discussion in the ADVANCED PROGRAMMING INFORMATION of this manual. This information could save you a great deal of time and frustration in trying to get your software to work correctly. For a more detailed discussion of MOVCPM and SYSGEN please refer to the large manual that came with your copy of CP/M.

14. SYSGEN

When you want to GENerate a SYStem on a disk you use the SYSGEN utility. Its function in life is to write the CP/M operating system to the reserved tracks of the specified disk. The operating system that it writes may come from another disk, from a disk file, or from an image placed in memory by MOVCPM.

To run SYSGEN just type the following at the CP/M prompt:

```
SYSGEN filename <ENTER>
```

The "filename" is optional and may be omitted if you do not wish to generate the system from a disk file. Normally this name will be along the lines of CPMxx.COM, where the 'xx' is a memory size in kilobytes such as a file generated by MOVCPM.

SYSGEN will announce itself with the following display:

```
TRS-80 Model 4 CP/M 2.2 SYSGEN version 2.xx
Copyright (c) (p) 1982 Digital Research Inc. - All rights reserved
Copyright (c) (p) 1984 Montezuma Micro/JBO - All rights reserved
```

If a file name was specified in the SYSGEN command line then <u>that</u> file will be loaded into memory at this time rather than the CP/M information from the system tracks of a specified drive. In the event you did not specify a file you will get the following prompt:

```
Select SOURCE drive for SYSGEN.
 [ A,B,...,P, or ENTER to skip ]:
```

If you are using SYSGEN to record a system placed in memory by MOVCPM then just push ENTER. To read a system into memory from an existing CP/M disk enter the drive that contains the system you want. This must be a valid drive, or it will be rejected. After you enter the drive SYSGEN will ask you to load the disk and push ENTER. The operating system will then be read from that disk into memory.

SYSGEN is now ready for the write phase. It will prompt for the target disk drive as follows:

```
Select DESTINATION drive for SYSGEN.
 [ A,B,...,P, or ENTER to skip ]:
```

Select the drive that you want to place the system on. Invalid or non-existent drives will be rejected and return to this prompt. Keep in mind that a drive will be considered invalid if the format that it is using has less than 2 or more than 8 reserved tracks, if it is being double-stepped (40 track disk in 80 track drive), or if it uses inverted data (Superbrain). Such characteristics in a drive format cannot be accommodated by the bootstrap program that initially reads CP/M into memory.

Once an appropriate disk drive has been selected SYSGEN will write the operating system to it. Should any errors occur, an error message will be displayed and SYSGEN will terminate. This will also be the case if the system to be written is found to be of an illegal memory size (less than 39k). Assuming no such problems exist SYSGEN will record the system and announce a successful completion. It will then return to the destination drive prompt. If you have another disk to write a system on select the drive as before. Otherwise push ENTER to return to CP/M.

Keep in mind that the type of system you get from SYSGEN depends on what kind of system you started with. If you took an existing system from another disk then the generated system will be configured in exactly the same way. However, if the system came from a disk file or from memory (via MOVCPM) it will not be configured at all and you will have to use CONFIG to customize it for your purposes. Remember, too, that SYSGEN only records a CP/M system on a disk. You will not be running under that system until you put the generated disk in drive A: and push the RESET button.

SYSGEN does not care what format a disk drive is using, if it has the right characteristics to allow a working system to be written on it. You may SYSGEN "foreign" disk formats for use with Montezuma Micro CP/M as long as SYSGEN approves of the format. This WILL NOT, of course, allow the "foreign" disk to run Montezuma Micro CP/M on its own computer. You should also not attempt to read the CP/M system from "foreign" disk formats in an attempt to make your Model 4 look like some other computer. This will be a futile effort and will lead to nothing useful.

15. ADVANCED PROGRAMMING INFORMATION

While this manual has attempted to tell you everything that you need to know in order to use CP/M, it does not purport to tell you all that you might want to know about the internal operation of the CP/M software. We have omitted such things from this manual because they are of interest to only a very small percentage of CP/M owners. A complete and comprehensive SYSTEM PROGRAMMER'S MANUAL is available for those persons needing it. A commented listing of the BIOS and complete details on how to interface with it are included in this manual. For those who need information only on how CP/M relates to the Model 4 computer we have included the following paragraphs.

15.1. Memory Usage

Regardless of what size CP/M system you are using there are some areas of memory that are dedicated for specific purposes. The top 3k of memory (addresses F400H to FFFFH) is used to address the Model 4 keyboard and video display RAM. Although this map is switched in by the BIOS only when needed, it should most definitely not be used to hold software which might be called due to interrupts or interaction with BIOS functions. In addition the last 128 bytes of memory (FF80H to FFFFH) are used for a local BIOS stack and should not be farkled with by anybody for any reason!

The lower 32k of memory (0000H to 7FFFH) is subject to short "blackouts" when memory drive M: is being accessed. This means it would be unwise to try to use drive M: in conjunction with interrupts.

The upper 64k expansion memory (0000H to FFFFH) will be initialized to E5H bytes at each cold boot. After that it will not be altered unless drive M: is written to. This is true, of course, only on 128k systems which have the Memory disk drive enabled when the system is saved to disk with the CONFIG utility.

15.2. Interrupts

The BIOS is very defensive about interrupts. It makes no use of them at all in any of its processing, but disables them during disk I/O. All device interrupts are disabled at reset time via port E0H, but this port is ignored by the BIOS after that. If you have a need for interrupts you will have to initialize port E0H for your own purposes.

Due to the hardware structure of the Model 4 the only choice of interrupt modes is mode 1. This vectors all maskable interrupts to location 0038H. Keep in mind that this is the same address used by DDT, SID, ZSID, and their bretheren for breakpoint vectoring! It is also used by other CP/M programs for RST processing, which makes interrupts a very risky proposition altogether.

15.3. Processor Clock Speed

When CP/M is booted the processor is set to run at 4Mhz. This is the speed that the software was written to run at and switching back to 2Mhz may cause problems in disk I/O. Likewise you may encounter some problems by increasing the clock speed through hardware modification. We cannot guarantee that all software will operate correctly when running at speeds higher than 4Mhz and we do not provide support for speeds greater than 4Mhz. It has also come to our attention that some early desktop Model 4s do not actually run at 4Mhz, but rather closer to 3.2Mhz. This is not true of the Model 4P or any of the gate array desktops (green screen and/or arrow keys clustered), and we do not know why it was designed this way.

15.4. Register Usage

Since CP/M was designed to run with the 8080 microprocessor, most CP/M programs do not use any of the additional registers provided with the Z80 microprocessor. We have made extensive use of the index registers (IX and IY) in both the BIOS and in the utility programs. However these registers are always preserved by the BIOS, so programs may use them without fear of "surprises." The alternate register set is never used by the BIOS or utilities.

16. BUG REPORT

We have provided you with a means to report problems, if any, you may experience with our implementation of CP/M 2.2.

To utilize this report just turn on your printer, press 'AP' and type at the prompt 'TYPE REPORT.BUG'. This will reproduce the form listed on the next page.

Please take the time to tell us EXACTLY the nature of your problem. We will use our best efforts to get to the solutions as quickly as possible. We may elect to incorporate a fix in future releases but remain under no obligation to inform any or all prior purchasers.

Please DO NOT CALL US ABOUT BUGS. Use the form. We are just not able to respond over the telephone. Problems (Bugs) have to be written out so they can be properly directed, discussed and solved. Please BE SPECIFIC. Statements like "The printer doesn't work sometimes." or "Ultra-BASIC won't run." are so vague that we cannot even respond to them. We hope you understand.

In the event you send materials to us such as diskettes and/or documentation please be sure your name and address is clearly marked on each item. We are only normal and we need this information so we know who the items belong to in the event things get separated.

CP/M 2.2 Release 2.30 BUG REPORT

Name:____ Date:__________________

Address:____

City, State & ZIp Code:____

Day Telephone: (   )___________________ Night: (   )________________________

****

CP/M 2.2 Version # ____________ Serial Number: ____________________________

Purchased From:______________________________________ Date:__________________

City & State:____

****

What application or utility program are you having problems with?

Program Name:____

Program Publisher:____

Describe EXACTLY the bug or problem you have discovered and a step by step procedure of how you encountered the problem.

____

____

____

____

____

Please enclose a backup copy of your system disk and application program so that we may duplicate your experience as closely as possible. Your diskettes will be returned but please be aware that the data may be destroyed.

NOTE: Even though programs that run on other CP/M machines can be converted to run on the Model 4/4P there is no assurance that the programs will execute on the Model 4/4P because of hardware incompatibilities. we are able to offer no assistance in such cases.

Mail this completed form and diskettes to:

MONTEZUMA MICRO
CP/M Support Department, Bug Room #2
Redbird Airport, Hangar#8
P.O. Box 763009
Dallas, Texas 75376-3009 U.S.A.

17. COMMONLY ASKED QUESTIONS AND PROBLEMS

This section contains answers to some of the questions that we have been asked that cannot be easily included in other parts of the manual. Please refer to this before writing or submitting a Bug Report, since the answer to your problem may already be here.

I just bought a software package from XYZ company. The disk label says that it is in Radio Shack Model 4 format, but I can't read the disk. Is it defective?

While it is possible that the disk is defective it is much more likely that you are not using the correct format to read it. Many CP/M program producers do not know that there is more than one CP/M format for the Model 4. You should also try Radio Shack CP/M Plus format, Holmes VID-80 format, and Memory Merchant format.

Everything that I print ends up on one line. How can I get the printer to space after printing one line?

Because most printers that are used on the Model 4 are set up to automatically perform a linefeed after each carriage return we ship CP/M configured to suppress the linefeed following a carriage return. If your printer does not do a linefeed automatically after each carriage return you will need to use the CONFIG utility to change this.

I have a copy of WordStar from my Kaypro 2 that I would like to use on the Model 4. When I try to run it, though, it prints strange characters on the screen and hangs up. Why won't WordStar run on your CP/M?

Some computers, most notably the Kaypro and Osborne series, are sold with CP/M and "bundled" programs such as WordStar, dBASE II, etc. These programs have been configured to use the video and keyboard codes unique to the computer that they were sold with. To change this information it is necessary to "install" the program for operation with the Model 4. Often, though, the installation program necessary to do that is either not included, or is crippled to prevent the program from being used on another machine. In such cases your only alternative is to buy a "generic", i.e. non-specific, copy of the program. We sell all of the popular programs at very competitive prices, and pre-install them for optimum use with our CP/M.

The ABC company has a software package that I am interested in. Will it run with Montezuma Micro CP/M?

If it runs under CP/M 2.2 using a Lear-Siegler ADM-3A terminal it should work with our CP/M. To be absolutely sure contact the ABC company directly and ask them. Should they have any questions about our CP/M we will be happy to answer them.

I used DUP to make a copy of a disk, but the copy has a scrambled directory and all of the files are missing or incomplete. Isn't this a bug?

One of the greatest strengths of our CP/M is the ability to read and write a wide variety of disk formats. Like all powerful tools, this can sometimes be dangerous. If, for example, you use DUP to copy a SYSTEM disk in a drive which is in DATA disk format the copy will proceed without error. DUP's copy option regards the disk as a collection of sectors, which it copies without regard to size or content. As long as the disk being copied has readable sectors where DUP expects them no error will be reported. Since a DATA disk has fewer, but larger, sectors than a SYSTEM disk this type of error will cause only part of the data to be copied resulting in a worthless, but error free, copy. When using DUP to make a copy read the screen carefully to make sure that the source drive is in the correct format for the disk that you are trying to copy.

Why haven't you included formats in the DISK.FDF file for TRSDOS and MS-DOS?

Neither of these operating systems uses a disk directory structure like that of CP/M. The code necessary to read and write such disks as though they were native to our CP/M would take far more memory than is practical. To move data back and forth we have created utility programs specifically for this purpose. They are part of MONTE'S TOOLKIT which is available at extra cost.

I just installed double-sided drives in my Model 4. When I try to format a double-sided disk with DUP I get verify errors on every track. Do I need a special version of CP/M to use double-sided drives?

The CP/M that you bought is capable of supporting double-sided drives. Unfortunately Radio Shack did not plan for such additions when the original Model 4 was designed. The cable which connects the drives to the disk controller has pin 32, the side select line, removed. When adding double-sided drives to your system you must replace either the pin or the entire cable. Then you need to run CONFIG to tell CP/M that the drive has two sides instead of one, which is how it is shipped.

I want to bring up ZCPR on my system. Where can I get the necessary information?

All of the information that you will need is available in the System Programmer's Manual, available at extra charge. Be advised that a fair amount of skill is necessary to use this document, and we are unable to offer any support for system modification.

18. REFERENCES

18.1. Reference Books

"CP/M Operating System manual"
by Digital Research, Inc.
Digital Research, Inc., Pacific Grove, Calfornia 1982

"The CP/M Handbook with MP/M"
by Rodney Zaks
Sybex Inc., Berkley, California 1980

"Mastering CP/M"
by Alan R. Miller
Sybex Inc., Berkley, California 1983

"Osborne CP/M User Guide"
by Thom Hogan
Osborne/McGraw Hill, Berkley, California 1982

"The Programmer's CP/M Handbook"
by Andy Johnson-Laird
Osborne/McGraw Hill, Berkley, California 1983

"Using CP/M"
by Ruth Ashley and Judi N. Fernandez
John Wiley & Sons Inc., New York, New York 1980

"CP/M Primer"
by Stephen M. Murtha and Mitchell Waite
Howard W. Sams & Co. Inc., Indianapolis, Indiana 1980

18.2. CP/M Magazines

"User's Guide (to CP/M Systems & Software)"
Excellent tutorial on how to operate common CP/M software. Published every other month by TUG, Inc., P.O. Box 3050, Stanford, CA 94305
Telephone (415) 851-4836

"Dr. Dobb's Journal"
Software Tools for Advanced Programmers. Published monthly by M & T Publishing, Inc., 2464 Embacadero Way, Palo Alto, CA 94303
Telephone (415) 424-0600

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